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A FAST-TRACK LATE-ENTRY PROGRAM FOR WOMEN IN ENGINEERING

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ABSTRACT

Fast-Track Late Entry Program for Women in Engineering

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The scarcity of women in engineering prompted the design of this program which moves eligible women into engineering with 12 months intensive course work. Qualifications for entry included a college degree with emphasis in math or science, underemployed or employed in non degree related work. Evaluation activities included program monitoring, score comparisons with regular students, staff interviews and women self-concept measurements. Problems encountered were low self-concept, extreme competition, family and financial concerns, and student-staff conflicts. A longitudinal study is planned.

A FAST-TRACK LATE-ENTRY PROGRAM FOR WOMEN IN ENGINEERING

INTRODUCTION

It is well documented that engineering has been a predominantly male profession. A tour of most industries employing engineers will verify this fact. Women have not yet made the inroads in engineering that they have in the fields of mathematics, physics and chemistry. The per cent of women graduates with engineering degrees in 1974 was considerably less than those of the fields of math, chemistry and physics.

Per cent Women Graduates-1974[1]

Mathematics	41.0%
Physics	8.5%
Chemistry	20.0%
Engineering	1.6%

Recently, attention has focused on this phenomena as women are beginning to move into the formerly male-dominated careers. As a result, universities have begun more intensive recruitment programs in interest women in engineering careers. Simultaneously, industry, government and the engineering profession itself have taken a more active role in attempting to draw more women into this field.

As a result, over 4,000 women were enrolled as freshmen in 1976 in the various engineering schools in the United States.[2] This figure suggests that if attrition is not too high and if universities provide the support necessary to motivate women who are in engineering,[3] then at the end of four years perhaps ten per cent of the 40,000 graduating engineers will be women.

There remains, however, a problem--what of the immediate need and

demand for women engineers? Is there a way to retrain women to function as engineers? Could this be done in a short time? What special qualifications should these persons bring into such a program? The search for these answers provided the basis for the concept of Fast-Track Late-Entry Program for Women in Engineering.

A Late-Entry Bachelor of Engineering Program had been developed at the University of Dayton. Its purpose was to provide a mechanism whereby more mature persons, working full-time in an engineering related field, could retrain to enter the engineering profession. Twenty-seven chemists and physicists (all male) from the Monsanto Mound Laboratories near Dayton, Ohio took part in this program. After a two year period, eighteen emerged with chemical engineering capabilities.

It seemed logical that the experience gained in the late-entry program could be used to develop a program whereby qualified women could move toward a goal of engineering at a relatively fast pace. Further, some of the courses could be modified for the fast-track late-entry approach. However, for the fast-track late-entry concept to work, there would have to be a link between the proposed curriculum and the area in which the proposed participants had received their earlier training.

A review of the necessary requirements indicated that it seemed reasonable that chemists could be retrained to function as chemical engineers and that mathematicians and physicists could be trained to function as electrical engineers. Similarity and overlap in the content of these areas made it seem feasible that the retraining could be compressed and fast-tracked. The desirability of the choice of chemical and electrical engineering was emphasized by the facts that (a) the top job and salary

offers were being afforded chemical engineers, and (b) competition for employment in the field of mathematics, where women comprise a comparatively large percentage of graduates was particularly keen.[4]

Thus the Fast-Track Late-Entry Program for Women in Engineering was proposed and consequently funded by the National Science Foundation in July, 1977. The goal of the project was to develop and implement a program to quickly produce a pool of women who could function at the bachelor's level of chemical or electrical engineering.

THE PROGRAM

The project was carried out in three Phases.

Phase I ran from the time of project approval by NSF (July 1977) to December of 1977. During this time curriculum was developed, revised and finalized. Recruitment and selection and administrative details for program implementation were carried out.

Curriculum work in Phase I consisted of selecting those courses which were basic for chemical and electrical engineering and molding them to fit the time frame allowed and the anticipated backgrounds of the participants. Chemical revisions were relatively minor because of the experience gained in the Monsanto Project. Since the Electrical revisions were fairly extensive most courses were developed into self-paced methodology.

Criteria for selection of participants were developed and set at (1) bachelor degree; (2) major or strength in chemistry, math or physics; (3) minimum math background of differential equations; (4) underemployed and/or dissatisfied with present employment with a desire to move ahead. A total of 65 firm applications were received. It was intended to have a

total of 40 participants (20 in each track), but due to the lack of background of some applicants only 31 were accepted (12 chemical and 19 electrical).

Phase II consisting of six 7-week terms, encompassed the 1978 calendar year. The prescribed courses earned each participant 30 hours credit, with little variation possible. One variation was that students could test out of the mathematics (few elected to do so). A second was that they could take some additional courses in the regular school of engineering schedule (several elected to do this at their own expense). Thirdly, although awarding of a degree in engineering was not an objective of the project, by the acquisition of additional credits and meeting local requirements, several women are very close to achieving this objective. Others could easily do so in the near future.

The Fast Track program began with a Motivational-Diagnostic Week, a portion of which was designed to provide a series of experiences giving psychological reinforcement to women entering an engineering program. In addition, individual counseling and testing was provided to diagnose strengths and weaknesses of the individual with respect to program success. The program also provided discussions with women presently successful in the field of engineering, dialogue with faculty on engineering and round-table discussions with industry representatives on opportunities for women in their organizations. A "Career Management Training Program" was also provided during this week to assist the women in positive motivation toward the future.

In addition to their regular classwork a number of related activites occurred during the year. "Focus Groups" were organized as a result of the "Career Management." These were small discussion groups focusing on problems arising from program participation. Problem-Solving Sessions

were available daily which assisted participants, through tutors, with problems related directly to their courses. Assistance was also given in study skills, the finding of part-time employment and for personal counseling.

Vocational assistance was handled in several ways in addition to the Motivational Week. The women were encouraged to participate (and all did) in a Career Awareness Workshop for freshmen and sophomore women interested in engineering. This workshop which took place in February featured presentations by women in engineering fields and provided information on engineering careers as well as opportunities in industry.

Engineers from area industries visited the campus on occasion and were available for discussion. Visits to industries were also provided. Finally a Career Education course was provided not only for career awareness, but to deal with the issues of seeking employment, especially as they apply to women.

Employment opportunities for program participants were provided through a two-day "Job Fair" near the end of the program. Twenty-five industry representatives were available for presentations and interviews.

EVALUATION ACTIVITIES

The major activities of evaluation during Phase I of the project consisted of the monitoring of curriculum discussions and the selection procedures.

During Phase II the objectives of the various special activities were incorporated into questionnaires and given to participants. In addition a general questionnaire was developed around participants activities, concerns and problems administered three times during the year to detect possible changes in participant's attitudes.

Personal interviews were conducted at mid-year.

At the end of the project information on job placement was obtained and compared with job information prior to program entry. Test information from Fast-Track and regular engineering students was gathered and compared.

The final evaluation will come as a result of a longitudinal study over the next two years. This will follow the progress of the individuals and is in progress.

FINDINGS

1. Of the 31 women entering the program, 27 completed the course. Three dropped out by the end of the first seven-week term. The other left at mid-year. Reasons given were other than ability to do the work.
2. Participants ranged in age from 24 to 48 years. Several were unemployed. Most others were underemployed and/or employed in a field not related to their education.
3. All were highly self motivated. This was evidenced by the hours spent on class preparation, completion of assignments at a rate that amazed instructors, and willingness to do work beyond that required.
4. While participants wanted to do well and worked hard, they did not have the self confidence that the project directors felt women in their position should have. Much time was given to building self-confidence. (A number of women were extremely proficient in math but refused to test out because of their fear of not doing well in related courses.)

5. The participants tended to be fiercely competitive among themselves constantly vying for top grades in the traditional lecture courses. Most were not satisfied with less than an A becoming very upset when not achieving at that level.
6. A comparison of common tests given the Fast-Track students and other students in similar courses showed the Fast-Track persons to be higher on the average on all tests, significantly in six of the ten comparisons. On a final examination of ten engineering problems a greater per cent of Fast-Track students achieved correct solutions on seven of the ten than did regular engineering students.
7. Although few women at the beginning of the project had a concept of what engineering was about and how engineers function, all but three achieved this objective by the end of the program and felt confident as entry level engineers.
8. All program participants except one were able to find immediate employment in the engineering field. The exception was a student living in this country on a temporary visa. Industry was unwilling to make a commitment to hire this person.
9. For those who were fully employed at the time of entry into the program, salaries ranged from $4000 to $16,000 with a median of $12,850. Engineering salaries for these same persons ranged from $14,400 to $20,000 with a median of $18,200.
10. The curriculum was generally taught through two methodologies, lecture for the chemical and self-paced for the electrical. Both methods seemed to be satisfactory to both students and staff, although the self-paced seemed to generate less stress and tension.

11. The objective of moving rapidly into the engineering field was attained. The success they have in the profession will be assessed by the longitudinal study.

PROBLEMS

1. The lead time from funding to program start was too short causing administrative and logistics problems in registering students, finding housing and similar details. A second request for funding expands the lead time to at least 8 months. The program started on the first day of the coldest several weeks in the history of southern Ohio. This had a negative emotional effect on the students for quite sometime.
2. A status conflict arose very quickly. Program participants were graduate students taking undergraduate work. Some areas of the University did not recognize this special status. Conflicts arose with a new professor who was relatively young and new to the teaching field. With that resolved it moved to another professor before it settled somewhat on the project director. It resided there for the most part and continued to simmer all year. However, this did not seem to interfere with the academic progress of students.
3. Finances became a major concern very quickly since students had no direct financial assistance other than tuition and remission of fees. Loss of salary for the year (even though small) was a problem. Those who had no financial help through husbands or family moved toward part-time employment. This was

an added responsibility for the project director. One unexpected development that fostered financial problems was living expenses. It was incorrectly anticipated that most of the participants would come from the Dayton area. But only five students were from the area. The rest had to relocate. (It is interesting that, of the four who dropped out, three were from the immediate area.)

4. The assumption that graduates with degrees in chemistry would have the necessary math background for chemical engineering was in error. It was discovered that a chemistry degree and mathematics do not go hand in hand. As a result the number of chemistry track participants was only one-half of what was expected and most of those needed intensive work to catch up.
5. Most of the women expressed dissatisfaction with continued all female classes.
6. Throughout the year there was little indication that the group was developing into one that was closely knit, bound together by common goals and interests. There was little group social interaction. Several early attempts at group activities were only moderately successful and were discontinued. Several reasons for this were evident; age discrepancies, diverse backgrounds, family status, and work. Several had set up temporary residence in Dayton and left each weekend. There was a general lack of cooperative work and participation.
7. Lack of orientation toward engineering was a problem in the early part of the program. About half of the women entered the program, not because they were enthused about engineering, but because

they were frustrated in their circumstances. The program offered a way out. They had little knowledge of what engineering was about. This lack of adequate orientation was in part the reason for the stress, lack of self confidence, and frustration in the early part of the program.

8. Considerable resentment grew among the regular male engineering students, especially seniors, who felt that the participants' special status was a threat to their being able to get a job. A male tutor in Problem Sessions became ineffective because of his uncooperative attitude and quite overt resentment of the Fast Track students.

The program offers a solution to two problems upon which program goals were built. (1) It provides women a way of moving rapidly into engineering fields where the supply at present does not meet the demand. (2) It provides an opportunity for persons who have made career choices for which there is little demand or very keen competition (chemistry, physics, math) the opportunity to retrain in a short period of time. Second year funding has been requested and negotiations are underway for a cooperative industry-university sponsorship of the project at the end of that time.

1. "Engineering Manpower Bulletin," 21:5, May 1972.

2. Engineering Manpower Commission, Engineers Joint Council. "Statistics on Women and Minority Students in Engineering." September 29, 1975.

3. Gardner, Robert E. "Decision Making by Female Undergraduates in Engineering," Women in Engineering: Beyond Recruitment. Ithica, New York: Proceedings of the Conference, Cornell University, June 22-25, 1975.

4. Grant, W. Vance and Lend, C. George, "Earned Degrees Conferred," Digest of Educational Statistics. Washington, D.C.: National Center for Educational Statistics, 1976

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